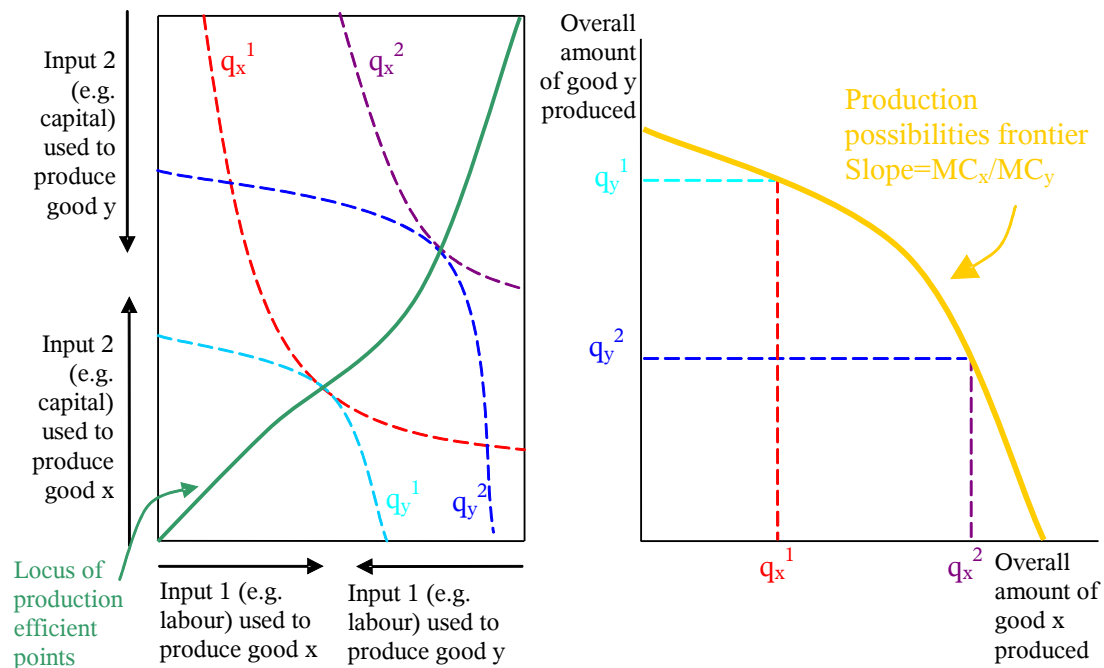


Topic 7 – General equilibrium and welfare economics

1. The production possibilities frontier is generated using a production Edgeworth box diagram with the input goods on the axes. The following diagram illustrates the process for a 2-input 2-output economy. We call the two inputs 1 and 2 and the two output goods x and y. Given a certain quantity of good x to be produced, we fix the position of an isoquant in the production Edgeworth box diagram. We then find the maximum amount of good y which can be produced given the endowment of inputs and the amount of good x by finding the highest isoquant for good y, which will form a tangency condition with the isoquant for good x. The set of these tangency conditions traces out the locus of production efficient points in the production Edgeworth box diagram and the production possibilities frontier in q_x, q_y space (where q_x and q_y are the quantities of good x and y produced, respectively). Note that the slope of the production possibilities frontier is the ratio of the marginal cost of good x to the marginal cost of good y (i.e. MC_x/MC_y). By reducing the amount of good x by 1 unit, we save an amount equal to MC_x (think of this in terms of cash). In order to transform this into units of good y, we must divide by MC_y since that is how much extra units of good y cost at the margin. The slope of the production possibilities frontier is also referred to as the **marginal rate of transformation (MRT)**:-



We now introduce two representative consumers A and B, who gain utility from consuming goods x and y (i.e. inputs 1 and 2 are only useful once converted into goods x and y). The idea is that the consumers represent two types, all of whom have the same preferences as others of their type. This is a simplification so that we can fit an entire economy on one diagram. Imagine also that there are many firms, each of which produces either good x or good y. Firms which produce good x all have identical production technology, as do all firms which produce good y. So, think of the isoquants in the production Edgeworth box as being the isoquants of a representative firm producing good x or good y. Since the firms are perfectly competitive, they do not make any profits in equilibrium. The firms therefore purely

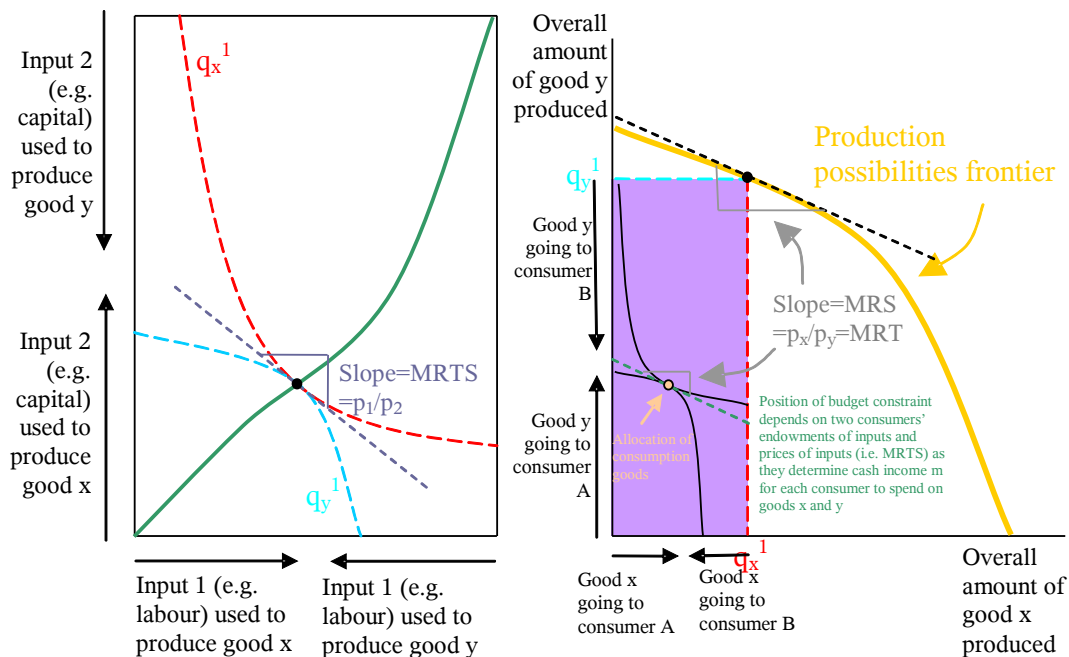
play the role of bringing about the necessary price adjustments to get to the competitive equilibrium. Once we are at the equilibrium, all that matters is the production technology (i.e. isoquant map in the production Edgeworth box diagram).

In a perfectly competitive economy, we know that a number of conditions must be fulfilled in equilibrium. Firstly the marginal rate of technical substitution MRTS (which is the slope of the isoquant of a firm at the optimal input mix given input prices and desired production level) for each firm/output must be equal to the price ratio of the two input goods (and therefore the MRTS must be the same for all firms). Otherwise, firms producing either of the goods could reach a higher output quantity whilst holding costs fixed, because their isocost line would cut their isoquant. If we imagine starting at a position away from equilibrium (as defined by the condition on the MRTS described above), there would be excess demand for one of the inputs and excess supply of the other, which would drive up the price of the scarce input until the prices were equal to the MRTS so that no firms will want to further alter their input mix. This condition, when we shortly consider it in the light of the requirements for a Pareto-efficient economy, is known as **production efficiency**.

The second condition which must be fulfilled is that the price ratio of the two output goods must be equal to the marginal rate of substitution (MRS) of both consumer A and consumer B at their chosen optimal consumption point. If we imagine an allocation which is **feasible** (i.e. the total amount of both goods is not greater than the total amount produced), then for this allocation to be a competitive equilibrium the above condition must be fulfilled. If it was not fulfilled, both consumers could reach a higher utility level whilst holding overall expenditure fixed by moving away from their current consumption bundle, and so there would be excess demand of one of the output goods and excess supply of the other. We would expect profit-maximizing firms producing the scarce good to raise their relative price, until consumers' demands for the two goods are compatible with the overall amount being produced. This could only occur at a feasible bundle which fulfils the condition described above, which is known as **consumption efficiency**.

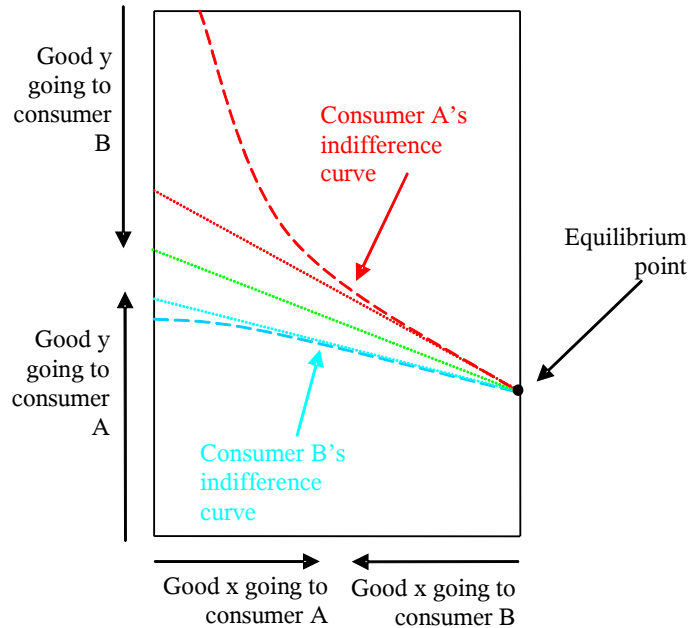
We cannot fully characterize the competitive equilibrium until we introduce the third condition, that of **allocation efficiency**. This concerns the optimal allocation of the input goods between the firms producing good x and the firms producing good y. It provides the final piece of the jigsaw which connects the first two conditions together. **Allocation efficiency** requires that the marginal rate of transformation at the competitive equilibrium be equal to the marginal rate of substitution between the two output goods for all consumers. To see why it must hold, note that in competitive markets all firms price their output at marginal cost. This implies that $MRS_A = MRS_B = p_x/p_y = MC_x/MC_y = MRT$.

Now that we have established that $MRS = p_x/p_y = MRT$, we can draw the consumption Edgeworth box within the production possibilities frontier and show how the price ratio, input mix and output mix between the two groups of consumers are all jointly determined at the competitive general equilibrium:



Pareto-efficiency requires that the allocation of inputs within and between the firms producing different outputs, and between the two groups of consumers, are such that we cannot make any changes without making someone worse off. The three conditions which are fulfilled by a perfectly competitive general equilibrium are necessary and sufficient to achieve this. Pareto-efficiency requires **production efficiency** because if the MRTS was different for firms producing good x and good y, we could raise the output level in both industries by moving input 1 from one of the industries into the other and input 2 in the opposite direction. This would clearly allow one or both consumers to be made better off without making the other worse off. Similarly, if **consumption efficiency** were not fulfilled, we could make both consumers better off by moving one of the output goods from one individual to the other, and the other output good in the opposite direction in compensation. Finally, if **allocation efficiency** were not fulfilled, then (assuming for simplicity the other two conditions are fulfilled) we could make both consumers better off by taking units of one good away and transforming them into the other output good, because that would increase both consumers' utility by more than the loss from the other good. Since these three conditions fully describe all the resource allocation decisions in this simple economy, they are also taken together a sufficient condition for Pareto-efficiency.

Although the above analysis did not allow for corner solutions in the consumer's optimal consumption bundles, these do not cause a serious problem (when convexity of preferences still holds) because although the condition that the MRS will be equalized between the two consumers no longer holds, Pareto-efficiency is still always achieved because at a corner solution (e.g. with all of good x going to consumer A in the diagram below), to move back into the region of feasible bundles always requires that the compensation required by one of the consumers is greater than the other would be willing to pay. For example, to reduce the amount of good x going to consumer A in the example below would require that consumer A be compensated at a higher rate than consumer B would be willing to pay (because the green price ratio line must lie between the two MRS slope lines in order for this to be a corner solution), so neither consumer can be made better off without making the other worse off.



The above analysis for a two-input, two-good, two-firm, two-consumer economy generalizes to an economy with lots of different types of goods, consumers and inputs. There will then exist marginal rates of substitution, technical substitution and transformation between all the different goods. However, the reasoning of the conditions that will have to be fulfilled by these in order for a competitive equilibrium to hold remains very similar. The model shows therefore, that an idealized perfectly competitive economy will be Pareto-efficient. This result is known as the **First Theorem of Welfare Economics**. It relies on a number of assumptions:

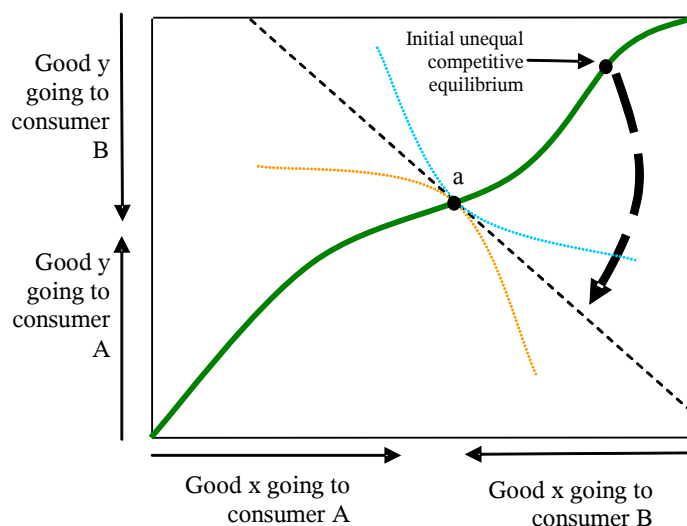
1. All consumers and firms must be **price takers**. This means they must have no influence over the market price; they simply take the prices of inputs and goods as fixed, and decide on the basis of these and their indifference curve or isoquant maps how much to purchase. The model thus rules out oligopoly among firms, unions among workers and many other kinds of real world economic behaviour. It is also theoretically problematic since it leaves no fully satisfactory answer to the question of how prices adjust so that we get to the competitive equilibrium in the first place.
2. There must be a market for all inputs and output goods. This means that there must be no externalities or public goods. This also strictly requires that there would have to be markets in all goods at all times in all places of the world. For example, it would have to be possible to buy and sell goods such as “an apple in my fruit bowl at 16:04pm today”. Since it is in reality impossible to trade goods at this level of specificity, we cannot really be sure that someone else wouldn’t get more utility from the apple than me at 16:04pm, since they have no opportunity to buy it from me at that specific time.

Do these considerations invalidate the importance of the competitive general equilibrium model and the First Theorem of Welfare Economics? No, because like all economic models it is meant to be a simplification of reality. Also, it is arguably not a justification of laissez faire market economics but rather a tool which can be used to argue that the government should actively intervene in order to make the economy as close to the perfectly competitive general equilibrium model as possible, since the allocation reached by the market mechanism will then be as close as possible to achieving the generally desirable property of Pareto-efficiency.

2. “Market economies are inherently inequitable, and there is little a government can do to change this.”

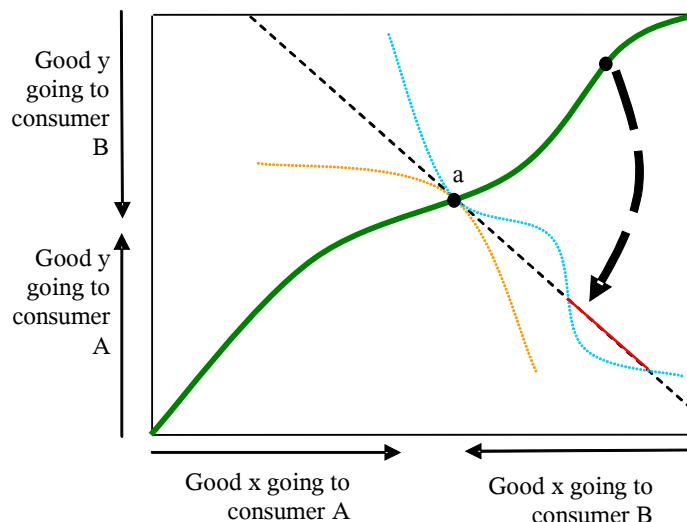
If this statement is taken to mean that there is nothing the government can do to make the market economy more equitable, then it is clearly false. If the government believed it was desirable, it could declare a maximum income and a 100% tax rate above it. It could abolish inheritance. The question really, then, is whether it can ever be socially desirable to follow policies whose aim is to make the market economy more equitable. It is not the absolute impossibility, but the huge social cost of doing so (essentially in the form of the deadweight loss from taxation), that one could argue will prevent a sensible government from ever acting to decrease inequality. However, even this second more tenable position is difficult to defend in the light of welfare economic theory. Although there probably is a trade-off between economic efficiency and equality, it is unlikely that the trade-off requires that the government should do nothing at all to make the market economy more equitable.

In fact, the **Second Theorem of Welfare Economics** suggests that under certain (very strong) conditions, there is no trade-off between efficiency and equity at all. If we can take income or wealth away from individuals in such a manner that they will be taxed the same amount regardless of their economic decisions, then we can redistribute utility without causing an efficiency loss at all. This can be illustrated for a simple two good exchange economy using an Edgeworth box. The government can either redistribute endowments of output goods, input goods (if we think of this as being part of a general competitive equilibrium like in question 1) or just cash income directly. Whichever way it chooses, the government must just ensure that we start off on the right budget constraint. The market will then ensure that we end up at a Pareto-efficient point on the contract curve. This means that the government does not need to intervene in the production process in order to achieve the most equitable Pareto-efficient outcome:



The assumptions required by the Second Theorem of Welfare Economics are stronger than those required by the first. Firstly, we must have strictly convex preferences if we are to be able to achieve any point on the contract curve as a competitive equilibrium via a price ratio. For example, suppose the indifference curve at the desired Pareto-efficient allocation *a* looked like the diagram below. Although point *a* is Pareto-efficient, it could not be a general equilibrium because consumer B would be better off moving to somewhere on the red part of the budget constraint. So,

the government would not be able to get to point a except by deliberately allocating resources and disallowing individual trade via a planned economy.

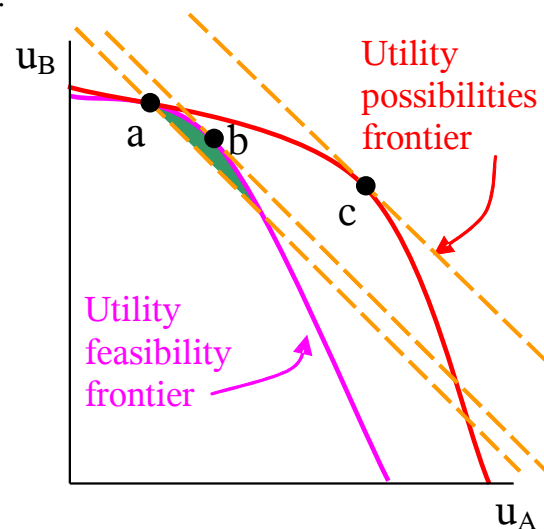


The requirement of strict convexity is not, however, the really decisive problem with the Second Theorem of Welfare Economics. A second, slightly more serious, problem, is that the only way to get to a specific point like a (referring back to the diagram with strictly convex preferences on the previous page) is to know exactly how much income to redistribute to get the economy onto the correct budget constraint. However, to know this would require that the government knows all consumers' preferences, but if the government knows this then why not just plan the economy anyway? There are a couple of answers to this criticism. Firstly, allowing consumers to trade is desirable from the point of view of individual freedom. This, however, is moving beyond the realm of welfare economics into political theory. The second argument is that the government may not care about the precise point we end up at, and simply wants to make it more equitable than the current position.

The most severe criticism of the applicability of the Second Theorem, however, is the fact that we cannot in reality tax people without altering their economic behaviour. For example, an inheritance tax will lead people to value wealth accumulation less, because they value other people's children less than their own. A labour tax will alter people's labour supply decision, and so on. This argument is in fact closely related to that concerning the information available to the government. If the government could simply pick individual rich people and declare that they must pay a certain annual amount for the rest of their lives, regardless of their behaviour, then it could achieve non-distortionary taxation. However, this would involve that (a) the government can be sure who will be rich and who will be poor right from birth and (b) there is no doubt in the minds of those being taxed that the government will continue to do so. However, in reality people would expect that if they become poorer the government would tax them less, and so this would alter their behaviour. The point is that it is impossible to use lump sum taxation to achieve greater "social justice", because greater "social justice" requires that people be treated differently according to their actual situations. One could perhaps envisage a higher lifetime fixed annual tax bill for all those born into richer families. However, there would always be specific cases of individual injustice in such a system (e.g. a person born rich who ends up poor), and so it is highly unlikely to be workable in practice.

Given that we accept that in reality the attempt to make the market economy more equitable is going to prevent it from achieving Pareto efficiency, we will have a trade off between equality and efficiency. Let us make favourable assumptions to the view that there is little the government can sensibly do to improve equity. We shall

assume that the economy is perfectly competitive and that there are no public goods or externalities, so that the initial equilibrium before wealth redistribution is Pareto efficient. We shall assume that in order to move away from this initial equilibrium, taxation will create a deadweight loss, pulling the economy below the production possibilities frontier and therefore below the **utility possibilities frontier**. The set of feasible allocations of utility once we take into account the deadweight loss of taxation is known as the **utility feasibility frontier**. We shall assume that the government runs society along utilitarian principles (“the greatest happiness to the greatest number”), so that all that matters is the sum total of utilities, and so the government prefers a single person to have 1000 units of utility and everyone else to have rather than 999 units to be equally shared out (this assumption is clearly an extreme one, which is being adopted for the sake of argument to show that wealth distribution can in fact still be justified). The diagram below illustrates the situation in terms of the social choice between utility for person B (the rich person), and person A, (the poor person).

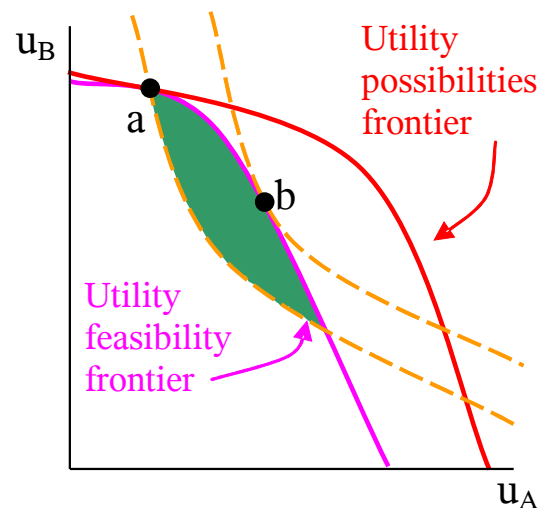


The utility feasibility frontier lies below the utility possibilities frontier at all points except point a because moving away from point a causes a deadweight loss due to the distortionary effect of taxation. The dotted orange lines are **social indifference curves**. They are straight lines because the utility of A and B are perfect substitutes from society’s point of view (i.e. utility of 10 to A and 0 to B is equally socially preferred to 0 to A and 10 to B or 5 to each, because the total utility is the same). The shaded dark green area is the set of points which are feasible (even despite the distortionary effect of taxation) and lie on a higher social indifference curve to point a. The **socially optimal feasible allocation** is point b. Note that this point is not Pareto-efficient as it lies below the utility possibilities frontier. It is a general feature of the socially optimal feasible allocation that it is not Pareto-efficient once we have distortionary taxation and inequality at the “laissez-faire” equilibrium point a. The point is that even a utilitarian society which does not care about the distribution of utility is likely to require some efficiency to be traded in exchange for greater equality. Point c is the socially optimal Pareto-efficient allocation. Under the assumptions we have made it is not achievable, but it would be the point chosen by a social planner if they had perfect information of all consumers’ preferences and firms’ technologies (i.e. of all the indifference curve and isoquant maps).

Note that in order to generate our utility possibilities diagram, we need to move from ordinal to cardinal utility, since we need to be able to say that 10 utils (units of utility) for person 1 is the same as 10 utils for person 2. Once we have

introduced cardinal utility in order to make interpersonal comparison of utility, we can argue that the utility possibilities frontier will be concave because as people get richer, they get declining marginal utility from additional amounts of goods. Although this is appealing, it is problematic in the sense that utility cannot really be observed directly. Some economists have argued that utility comparisons between individuals are meaningless, and so Pareto-efficiency is the only desirable property of a social allocation of resources. However, provided we are willing to admit that our welfare economic analysis is a framework for normative judgement rather than a predictive framework like the model of consumer choice, then it is a useful theoretical approach. When we make statements like “it would be better to spend 1 million pounds on aids drugs for Africa rather than on the royal family” then we are implicitly making interpersonal comparisons of utility.

Once society cares about equality as well as the total amount of utility we have indifference curves which are convex to the origin. This creates a greater tendency for utilities to be equalized at the social optimum, as illustrated by the new, more equal socially optimal feasible allocation point b shown below:



The most attractive argument for why social indifference curves should be convex is that they should represent the preferences of someone who must decide upon the allocation of utility **before** they know whether they are person A or person B. If people are risk averse, they will prefer to have a more equal utility distribution between A and B, so that they do not have to take such a large risk of ending up being the low-utility individual. This justification for the standard model with convex social indifference curves is capturing neatly the idea that society should be run in the best interests of everyone independently of their position in society, not just those who turn out to be lucky and rich. Note also that convex indifference curves do **not** imply that the government should iron out **all** inequality; that would only occur if the utilities of the two individuals were perfect complements (implying L-shaped indifference curves) (the Rawlsian s.w.f. named after the philosopher John Rawls).